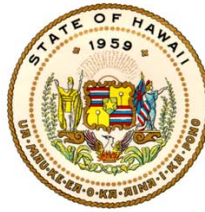




**US Army Corps
of Engineers®**



Limited Visual Dam Safety Inspection Summary Report

HI - 00052

Kehena Reservoir

Hawaii, Hawaii

Prepared by:

**U.S. ARMY CORPS OF ENGINEERS
HONOLULU ENGINEER DISTRICT**

**STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES**

May 2006

Limited Visual Dam Safety Inspection Conducted on: 6 April 2006

I. Purpose:

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections were authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statutes, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections were conducted under joint agreements of the U.S. Army Corps of Engineers (ACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection was performed on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works included the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may or may not have appeared to be any immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

Dam ID: HI00052
Name: Kehena Reservoir

V. Inspection Team

Organization

U.S. Army Corps of Engineers
National Resource Conservation Service

Name

Troy Cosgrove
Sherman White

VI. Owner's Representatives Present

Mr. Michael Bryan, Parker Ranch

VII. Summary Report Team

Organization

U.S. Army Corps of Engineers

State of Hawaii, Dept. of Land and Natural Resources

Name

Derek Chow
Joseph Koester
Denise Manuel
Edwin Matsuda

VIII. Dam Type

The dam is an earthen embankment.

IX. Dam Classification

The current hazard classification of this dam is: Unclassified
Based on available data, this classification is believed to still be applicable.

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Small

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally described the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

A. General appearance:

The reservoir and dam features were easily recognizable. The dam appears to have breached, and has approximately 50 foot section of embankment missing.

Based on staff personnel, this reservoir breached around 2003-2004 with minimal downstream damage.

Modifications / Improvements: There were no signs of any recent modifications. The reservoir appeared to have a small surface drainage area. They have no plans to repair the dam.

Findings and Corrective Actions:

- a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- b. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- c. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences, which may adversely affect the dam or reservoir.
- d. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
- e. Power / Communication: There were no communication systems observed on this reservoir. There were no utility or power poles visible nearby.

B. Access / Security:

Access to the dam was accomplished via a County roadway. Access requires a 4 wheel drive vehicle.

Any security issues. Access to the dam is via several locked gates.

C. Inflow Works:

The inflow works were not observed. However according to staff personnel, the reservoir is fed by another upstream reservoir.

It was not clear whether the intake or inlets have the ability to be shut off or diverted away from the reservoir during periods of heavy rains.

Findings and Corrective Actions:

- a. The intake works were not inspected.
- b. The intake works were not tested.

D. Reservoir

The reservoir level during the inspection was very low; only a few feet of residual pool remains in a small area. There is no staff gage.

According to staff personnel, the reservoir is kept empty or low.

Findings and Corrective Actions:

- a. The dam has been breached and is no longer operated to retain a pool.

E. Upstream Slope (Fair/Poor)

The upstream slope is about 1V: 3H (Vertical/Horizontal).

A fitted riprap rock slope protection was observed. Vegetation was observed growing between the rocks.

Erosions were not observed, the slope was not entirely visible.

Cracks were not observed, the slope was not entirely visible.

Sinkholes were not observed, the slope was not entirely visible.

The upstream slope was not entirely visible due to grass vegetation.

Findings and Corrective Actions:

- a. The upstream slope was not inspected.
- b. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- c. Dam has breached and no longer retains a pool.

F. Crest: (Unknown)

The dam crest was approximately 15 feet wide.

Cracks were not observed, however the crest was not entirely visible.

Sinkholes were not observed, however the crest was not entirely visible.

Trees are growing along the crest.

Findings and Corrective Actions:

- a. The dam crest was not inspected.
- b. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- c. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- d. The dam has breached and no longer retains a pool.

G. Downstream Slope: (Unknown)

The slope was around 1V to 2H.

The downstream slope was not inspected.

H. Abutments / Toe: (Unknown)

The abutments/toe were not inspected.

I. Outlet Works: (Unknown)

Not inspected in detail, not tested.

The outlet works were not inspected.

J. Spillway: (Unknown)

The spillway was not inspected.

The dam has breached and no longer retains a pool.

K. Down Stream Channel: (Unknown)

The down stream channel was not investigated.

XI. Additional Comments:

The dam breached, with little downstream damage, sometime during 2003-2004. The dam was originally breached in the 1970's, but the breach was filled and the reservoir was allowed to begin retaining water in the late 1990's to early 2000. The dam began to seep and failed by breaching near the outlet works. The owner's representative stated that they currently do not plan to repair this structure. The flow that enters the reservoir flows into a small residual pond and then out the breach, uncontrolled. The breach is approximately 50 ft wide.

Original field inspection notes were scanned and are attached to this summary report. Included are several photos from the site visit to detail important features of the project, captioned to be self-explanatory.

Per e-mail dated 4/27/2006 10:25 am from Troy Coserove, USACE.

Intake Works Description: **The intake works was not visible, but I believe it was a ditch.**

Please provide description. If it is a ditch/flume/culvert. **Not inspected.**

Type of control, size and type or surface. **Not inspected.**

Upstream slope: Please provide information on the erosion, cracks, sinkholes and vegetation that you may have observed.

Erosion, cracks, and sinkholes were not inspected due to the dense high grass.

Crest:

Please provide information on the erosion, cracks, sinkholes and vegetation that you may have observed. **Erosion, cracks, and sinkholes were not visible due to the dense high grass, bushes and trees (6-20").**

Downstream slope:

Please provide information on access and slope protection. **There is a road along the toe of the structure.**

Please provide information on the erosion, cracks, sinkholes and vegetation that you may have observed. **Erosion, cracks, and sinkholes were not visible due to the dense high grass, bushes and trees (6-20").**

Was seepage observed? **None observed. No pool.**

Abutments/toe:

Please provide information on the erosion, cracks, sinkholes and vegetation that you may have observed. **Erosion, cracks, and sinkholes were not visible due to the dense high grass, bushes and trees (6-20").**

Was seepage observed? **None observed. No pool.**

Outlet works:

Please provide information on the erosion, cracks, sinkholes and vegetation that you may have observed. **None observed. No pool.**

Was seepage observed? **None observed. No pool.**

Downstream channel:

The downstream channel was not inspected.

Comments:

The dam has breached and does not hinder bypass flow. The dam does not present a hazard at the time of inspection.

PHOTOGRAPHS

Dam ID: HA-052

Name: Kehena Reservoir



Photo 1 Outlet intake.



Photo 2 Reservoir overview.

Dam ID: HA-052

Name: Kehena Reservoir



Photo 3 Filled in breach/spillway.



Photo 4 Breach in dam near outlet works.

Dam ID: HA-052

Name: Kehena Reservoir



Photo 5 Side slope of breach.



Photo 6 Downstream slope.

Dam ID: HA-052

Name: Kehena Reservoir



Photo 7 Outlet tunnel, no longer used.



Photo 8 Dam crest.

FIELD INSPECTION SHEETS

Dam ID: HA-0052

KEHENA RESERVOIR

Vulnerability Index:

Extreme	High	Moderate	Low
1	2	3	4

Inspection No:

Date: 4/6/06

 STATE OF HAWAII - DLNR
 DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present

Affiliation

Phone Number

Troy Cosgrove

US Army Corps of Engineers

215-656-6664

Sherman White

NRCS

808-933-8355

Michael Bryan

Parker Ranch

808-885-2301

Weather Condition:

☒ Rain previous day☐ Rainy☒ Drizzle / Mist☐ Cloudy/Overcast☒ Partly Cloudy☐ Sunny☐ Dry

Comments:

1. General: (Information currently on file, update as required)

Dam/Res. Name KEHENA RESERVOIR

Owner Parker Ranch

(C043)

Owner Contact Mr. Michael Bryan

Owner Ph.

Lessee

Lessee Ph.

O & M Contractor

O & M Ph.

Nearest Town HAULAULA

Latitude 20.1667° (decimal)

County HAWAII

Longitude 155.8033° (decimal)

Tax Map Key(s) (3)5-8-002:010

Dam Status

A:

Hazard Potential

U:

Dam Size

Year Completed 1930

Dam Length

1800 ft.

Dam Height

18 ft.

Normal Storage 57 ac.ft.

Max. Storage

57 ac.ft.

Max. Surface Area

ac.

Drainage Area mi.

Spillway Type

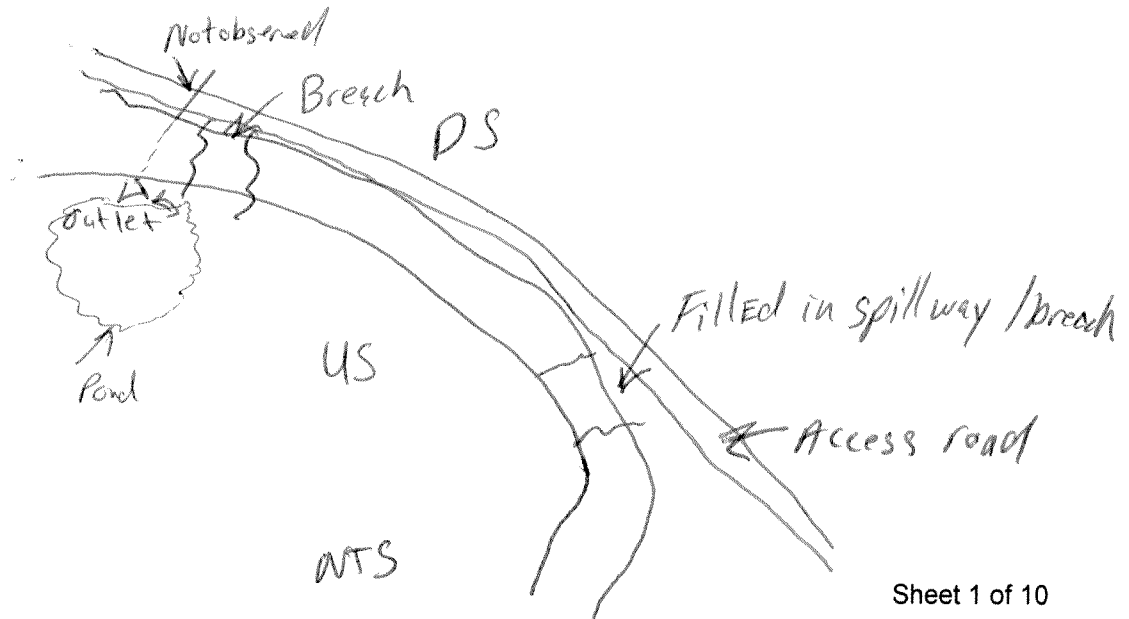
Max. Spillway Q

cfs

Owner owns land under dam facility:

Emergency Action Plan on file with the Department: NO

Reports on file with the Department: None on file.



2. Questions for Owner's Rep.:

	Yes	No	Unknown	Comments
Construction Plans Available	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Site / Facility Map	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Operation & Maintenance Manual	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Modifications / Improvements	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Conduct Routine Inspections	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Conduct Routine Maintenance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Vehicle access to site	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input checked="" type="checkbox"/> Requires 4-Wheel Drive
Access during heavy rains	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input checked="" type="checkbox"/> Requires 4-Wheel Drive
Access when spillway is flowing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Other Studies Conducted	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Phase I <input type="checkbox"/> Phase II <input type="checkbox"/> Hydraulics <input type="checkbox"/> Stability <input type="checkbox"/> Hazard <input type="checkbox"/> Seismic <input type="checkbox"/> Other: _____
Incident History	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Breached <input type="checkbox"/> Overtop <input type="checkbox"/> Slide <input type="checkbox"/> Down stream Flooding <input type="checkbox"/> Other: _____
Reservoir's Current Use	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Sediment <input type="checkbox"/> Irrigation <input type="checkbox"/> Recreation <input type="checkbox"/> Flood Control <input type="checkbox"/> Drinking Water <input type="checkbox"/> Power Generation <input type="checkbox"/> Other: _____

Findings and Corrective Actions:

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☐ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- ☒ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☐ f. Routine inspection logs were not inspected.
- ☐ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☐ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☒ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☐ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☐ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. _____

Additional Requirements:

The following investigative study(s) are:

Required Recommended

- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Phase I Study |
| <input type="checkbox"/> | <input type="checkbox"/> | Phase II Study (Including <input type="checkbox"/> Seepage <input type="checkbox"/> Hydrology/Hydraulics <input type="checkbox"/> EAP) |
| <input type="checkbox"/> | <input type="checkbox"/> | Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity) |
| <input type="checkbox"/> | <input type="checkbox"/> | Stability Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Seismic Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Hazard Classification |
| <input type="checkbox"/> | <input type="checkbox"/> | Other: _____ |

Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir:

Level during inspection unknown ft per N/A (gage / other)

Normal Operating Level/Range unknown ft per N/A (gage / other)

Description: Reservoir has bresched and maintains a few feet of water in a small aread.

Typical Operation ☐ Spillway always flowing ☐ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms

☒ Other: Bresched, is not operated

Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☐ Not Visible ☒ None Observed

Description: _____

Staff Gage: Description: N/A

Findings:

- ☐ a. The reservoir was not inspected.
- ☐ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.
- ☒ e. Reservoir empty, only a small portion of area fill with a few feet of water

Corrective Actions:

- ☐ e. The staff gage needs maintenance and/or repair. Description: _____
- ☐ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
- ☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
- ☐ h. _____

4. Intake Works Description:

☒ Number of Intakes 1, over flow from another reservoir

☐ Intake Culvert / Pipe

Size: _____ in. ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

☐ Ditch / Flume

Dimension: _____ (Size x Depth) Shape _____

Surface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ _____

Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

Findings:

- ☒ a. The intake works were not inspected.
- ☒ b. The intake works were not tested.
- ☐ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

- ☐ f. The intake works needs maintenance and/or repair. Description: _____
- ☐ g. _____

Dam ID: HA-0052

KEHENA RESERVOIR

Inspection No: _____

Date: 4/6/06

5. Upstream Slope:

(Typical Slope \pm 1V: 3H)

Slope Protection: ☐ None ☐ Dumped Rock ☒ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner ☐ Other: _____

☐ Defect in Protection: Description: _____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☐ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☐ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

- ☒ a. The upstream slope was not inspected.
- ☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ k. _____

Dam ID: HA-0052

KEHENA RESERVOIR

Inspection No: _____

Date: 4/6/06

6. Crest:

Approximate Crest Width: 215 ft

Access: ☐ None ☐ Walking Path ☐ Roadway, Surface / Width / Usage: _____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☐ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

- ☒ a. The dam crest was not inspected.
- ☐ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: _____
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: _____
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. _____

Dam ID: HA-0052

KEHENA RESERVOIR

Inspection No: _____

Date: 4/6/06

7. Downstream Slope:

(Typical Slope \pm 1V: 2H)

Access: ☐ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☐ None Observed

Slope Protection: ☐ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☐ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Seepage: Seep Spot Number 1

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☒ a. The downstream slope was not inspected.
- ☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
- ☐ k. _____

8. Abutments/Toe:

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☐ None Observed
 Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☐ None Observed
 Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"
 Description: _____

Seepage: Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description: _____
 Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
 Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description: _____
 Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
 Description: _____

Findings:

- ☒ a. The abutments/toe were not inspected.
- ☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair.
 Description: _____
- ☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ l. _____

Dam ID: HA-0052

KEHENA RESERVOIR

Inspection No: _____

Date: 4/6/06

9. Outlet Works:

Culvert / Pipe

Type / Size: _____

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control Type: ☐ Gate ☐ Valve ☐ Other _____

Location: ☐ Control on Upstream side ☐ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☒ a. The outlet works were not inspected.
- ☐ b. The outlet works were not tested.
- ☐ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.
- ☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. _____
- ☐ j. _____

10. Spillway:

Not inspected

Type:

☐ None ☐ Culvert/Pipe ☐ Channel

Description: _____

Dimension: _____ ft. Invert elevation: _____ ft. per staff gage

Slope Protection: ☐ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Concrete

☐ Defect in Protection: Description: _____

Approach: ☐ Clear ☐ High Veg. ☐ Trees ☐ Other: _____

Erosion: ☐ Scour ☐ Gully ☐ Headcut ☐ Not Observed ☐ Other: _____

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

- ☐ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ b. The Spillway appeared to be in fair to poor condition and requires corrective action.
- ☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ d. Slope protection needs maintenance or repair. Description: _____
- ☐ e. The spillway approach was blocked. Clear approach.
- ☐ f. Severe scour erosion was observed which requires maintenance and/or repair.
Description: _____
- ☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.
- ☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
- ☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
- ☐ j. _____

11. Down Stream Channel:

Name: _____

Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☐ Defined Drainage-way ☐ Other _____

Items along Stream Bank: ☐ None ☐ Road ☐ Houses ☐ Town ☐ Not Inspected

Description: _____

Findings:

- ☐ a. The downstream channel was not inspected.
- ☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. _____

Dam ID: HA-0052

KEHENA RESERVOIR

Inspection No: _____

Date: 4/6/06

Additional Comments:

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

This dam breach, with little down stream damage, in 2003-2004 time frame. The dam was originally ~~a~~ breach in the 1970's, but in the late 90s ^{or} ~~in~~ early 2000's the breach was filled and the reservoir was allowed to impound water. The dam began to seep and fail by breaching near the outlet works. The owner's representative stated that they currently are not planning to repair this structure. The flow that enters the reservoir flows into a small pond and then out the breach. The breach is approximately 50ft wide.

Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statutes Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003